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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant:	Yasuhisa KITAHARA
Title:	COMBUSTION CONTROL FOR ENGINE
Appl. No.:	10/526,489
International Filing Date:	7/7/2004
371(c) Date:	3/4/2005
Examiner:	Loren C. EDWARDS
Art Unit:	3748
Confirmation Number:	1853

BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents
P.O. Box 1450
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Sir:

Under the provisions of 37 C.F.R. § 41.37, this Appeal Brief is being filed together with a credit card payment form in the amount of $540.00 covering the 37 C.F.R. 41.20(b)(2) appeal fee. If this fee is deemed to be insufficient, authorization is hereby given to charge any deficiency (or credit any balance) to the undersigned deposit account 19-0741.

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1. REAL PARTY IN INTEREST

The real party in interest is the assignee of record, NISSAN MOTOR CO., LTD.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

3. STATUS OF CLAIMS

Claims 1 and 15 are cancelled. Claims 2-14 and 16-36 are pending in the application. Claims 2-14 and 16-36 are rejected and are the subject of this appeal.

4. STATUS OF AMENDMENTS

The present application is under a final rejection (See Final Rejection mailed March 7, 2008). Appeal of claims 2-14 and 16-36 is appropriate because all of the claims have been twice rejected. See 35 U.S.C. § 134(a). There are no amendments after final rejection.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The invention of independent claim 2 is directed to a combustion control apparatus for an internal combustion engine (FIG. 1, engine 1), comprising: an exhaust purifier (FIG. 1, NOx trap 13 and DTF 14) in an exhaust passage of the internal combustion engine; a combustion controlling actuator (FIG. 1, throttle valve 6, injectors 10, EGR valve 19) to cause main combustion, and to cause preliminary combustion prior to the main combustion; and a controller (FIG. 1, ECU) to control fuel injection to produce the preliminary combustion (specification, page 8, lines 6-10), and to control fuel injection to start the main combustion after an end of the preliminary combustion (specification, page 10, line 27 to page 11, line 3, page 12, lines 14-21); wherein the combustion controlling actuator includes a fuel injector (FIG. 1, injectors 10) to inject fuel directly into a combustion chamber of the engine; and the controller is configured to perform a preliminary fuel injection to produce the preliminary combustion at or near top dead center (specification, page 10, line 27 to page 11, line 3), and to perform a main fuel injection to start the main combustion after the preliminary combustion is finished (specification, page 10, line 27 to page 11, line 3, page 12, lines 14-21) such that a premixed combustion process is predominant in the main combustion (specification, page 13, lines 6-9), the preliminary fuel injection being immediately prior to the main fuel injection (See heat release bumps in FIG. 15), and wherein the controller is configured to perform the preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center (See first heat release bump in FIG. 15 beginning before top dead center and ending after top dead center).

The invention of independent claim 30 is directed to a combustion control process for an internal combustion engine (FIG. 1, engine 1) provided with an exhaust purifier (FIG. 1, NOx trap 13 and DTF 14) in an exhaust passage of the internal combustion engine, the combustion control process comprising: controlling fuel injection to produce preliminary combustion (specification, page 8, lines 6-10) in an engine cycle by performing a preliminary fuel injection to produce the preliminary combustion at or near top dead center (specification, page 10, line 27 to page 11, line 3); and controlling fuel injection to start main combustion

after an end of the preliminary combustion (specification, page 10, line 27 to page 11, line 3, page 12, lines 14-21) in the engine cycle by performing a main fuel injection such that a premixed combustion process is predominant in the main combustion (specification, page 13, lines 6-9), the preliminary fuel injection being immediately prior to the main fuel injection (See heat release bumps in FIG. 15), the preliminary fuel injection being performed at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center (See first heat release bump in FIG. 15 beginning before top dead center and ending after top dead center).

The invention of independent claim 32 is directed to combustion control apparatus for an internal combustion engine (FIG. 1, engine 1), comprising: means for determining (means plus function element under 35 U.S.C. 112, sixth paragraph, FIG. 1, ECU 25 and sensors 16, 17, 22 and 23) an estimated condition of an exhaust purifier (FIG. 1, NOx trap 13 and DTF 14) in an exhaust passage of the internal combustion engine; means for producing a split combustion request (means plus function element under 35 U.S.C. 112, sixth paragraph, FIG. 1, ECU) in accordance with the estimated condition of the exhaust purifier; and means for controlling fuel injection (means plus function element under 35 U.S.C. 112, sixth paragraph, FIG. 1, ECU, injectors 10) to the engine in a split combustion mode in response to the split combustion request by controlling fuel injection to perform a preliminary fuel injection to produce preliminary combustion (specification, page 8, lines 6-10) and controlling fuel injection to perform a main fuel injection to start main combustion after an end of the preliminary combustion (specification, page 10, line 27 to page 11, line 3, page 12, lines 14-21) such that a premixed combustion process is predominant in the main combustion (specification, page 13, lines 6-9), the preliminary fuel injection being immediately prior to the main fuel injection (See heat release bumps in FIG. 15), the means for controlling the fuel injection including means for performing the preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center (See first heat release bump in FIG. 15 beginning before top dead center and ending after top dead center), the means for controlling the fuel injection including means for performing the preliminary fuel injection at

such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center (See first heat release bump in FIG. 15 beginning before top dead center and ending after top dead center).

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection to be reviewed on appeal are:

A. the rejection of claims 2-4, 7-15, 17, 18, 27-30 and 33-35 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,688,279 to Ishikawa et al. (hereafter "Ishikawa") in view of U.S. Patent No. 6,412,276 to Salvat et al. (hereafter "Salvat");

B. the rejection of claims 5, 6, 19, 31, 32 and 36 under 35 U.S.C. § 103(a) as being unpatentable over Ishikawa in view of U.S. Patent No. 4,685,290 to Kamiya et al. (hereafter "Kamiya");

C. the rejection of claims 16, 20, 21 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Ishikawa in view of U.S. Patent No. 6,804,952 to Sasaki et al. (hereafter "Sasaki"); and

D. the rejection of claims 22-25 under 35 U.S.C. § 103(a) as being unpatentable over Ishikawa in view of U.S. Patent No. 6,796,118 to Kitahara (hereafter "Kitahara").

7. ARGUMENT

A. The rejection of claims 2-4, 7-15, 17, 18, 27-30 and 33-35 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,688,279 to Ishikawa et al. (hereafter "Ishikawa") in view of U.S. Patent No. 6,412,276 to Salvat et al. (hereafter "Salvat").

Independent claim 2 recites "the controller is configured . . . to perform a main fuel injection to start the main combustion after the preliminary combustion is finished," and "wherein the controller is configured to perform the preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center." Thus, in claim 2, preliminary fuel injection is performed at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center, while the main fuel injection is performed to start the main combustion after the preliminary combustion is finished. The references applied in the rejections fail to disclose at least this feature of claim 2, and in particular Ishikawa does not disclose performing a preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center, and additionally performing main fuel injection to start the main combustion after the preliminary combustion is finished.

Ishikawa discloses a compression-ignition internal combustion engine including a controller 26 for conducting pilot fuel injections (1) through (4) and a main fuel injection. FIGs. 3 and 4 of Ishikawa disclose the rate of heat release for the pilot fuel injections under the conditions where the pilot injection quantity is 6 mm^3/st and 1.2 mm^3/st, respectively (See col. 9, lines 13-19, 36-40). Ishikawa discloses that the pilot injection should be performed such that the maximum heat release is 60 kJ/s or less (col. 9, lines 51-54).

Ishikawa, however, does not disclose as recited in claim 2, performing a preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead

center, and additionally performing main fuel injection to start the main combustion after the preliminary combustion is finished. With respect to the feature where the preliminary fuel injection is performed so as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center, the Patent Office on page 3 of the Final Action refers to FIG. 4. The only peaks for heat release shown in FIG. 4 of Ishikawa, however, are for pilot injections (3) and (4), where these peaks indicate that the combustions corresponding to the pilot injections begin and end prior to compression top dead center. Moreover, Ishikawa discloses that the optimum timing for conditions for FIG. 4 (condition C) correspond to an angle of 27° BTDC, which corresponds approximately to pilot injection (3), which more clearly has a combustion beginning and ending before top dead center as indicated by the heat release in FIG. 4.

The Patent Office on page 14 of the Final Action states that Ishikawa's FIG. 4 shows a slight heat release which starts before and continues past top dead center. However, presuming for the sake of argument that any slight heat release shown in FIG. 4 of Ishikawa is a preliminary combustion caused by a preliminary injection, nowhere does Ishikawa disclose with respect to FIG. 4, that the combustion from the main injection starts after the slight heat release stops. In this case, Ishikawa does not disclose performing a main fuel injection to start the main combustion after the preliminary combustion is finished. Thus, presuming for the sake of argument that Ishikawa in FIG. 4 discloses a preliminary combustion that starts before compression top dead center and ends after compression top dead center, Ishikawa does not disclose starting the main combustion after the preliminary combustion is finished.

Salvat was cited for disclosing other features of claim 2, namely a particulate filter, but fails to cure the deficiencies of Ishikawa.

Independent claims 30 and 32 respectively recite features corresponding to those discussed above with respect to claim 2, and are thus patentable for analogous reasons.

Dependent claims 3-4, 7-15, 17, 18, 27-29 and 33-35 are patentable for at least the same reasons as their respective independent claims, as well as for further patentable features recited therein.

B. The rejection of claims 5, 6, 19, 31, 32 and 36 under 35 U.S.C. § 103(a) as being unpatentable over Ishikawa in view of U.S. Patent No. 4,685,290 to Kamiya et al. (hereafter "Kamiya").

As discussed above, Ishikawa does not disclose the features of independent claim 2 of performing a preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center, and additionally performing main fuel injection to start the main combustion after the preliminary combustion is finished, or the corresponding features of independent claims 30 and 32. Kamiya was cited for other features of the claims, but fails to cure the deficiencies of Ishikawa.

Dependent claims 5, 6, 19, 31 and 36 are patentable for at least the same reasons as their respective independent claims, as well as for further patentable features recited therein.

C. The rejection of claims 16, 20, 21 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Ishikawa in view of U.S. Patent No. 6,804,952 to Sasaki et al. (hereafter "Sasaki").

As discussed above, Ishikawa does not disclose the features of independent claim 2 of performing a preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center, and additionally performing main fuel injection to start the main combustion after the preliminary combustion is finished, or the corresponding features of independent claims 30 and 32. Sasaki was cited for other features of the claims, but fails to cure the deficiencies of Ishikawa.

Dependent claims 16, 20, 21 and 26 are patentable for at least the same reasons as their respective independent claims, as well as for further patentable features recited therein.

D. The rejection of claims 22-25 under 35 U.S.C. § 103(a) as being unpatentable over Ishikawa in view of U.S. Patent No. 6,796,118 to Kitahara (hereafter "Kitahara").

As discussed above, Ishikawa does not disclose the features of independent claim 2 of performing a preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center, and additionally performing main fuel injection to start the main combustion after the preliminary combustion is finished, or the corresponding features of independent claims 30 and 32. Kitahara was cited for other features of the claims, but fails to cure the deficiencies of Ishikawa.

Dependent claims 22-25 are patentable for at least the same reasons as their respective independent claims, as well as for further patentable features recited therein.

8. CONCLUSION

For the foregoing reasons, it is submitted that the PTO's rejections are erroneous, and reversal of the applied rejections is respectfully requested.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check or credit card payment form being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Appellants hereby petition for such extension under 37 C.F.R. §1.136 and authorize payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date November 4, 2008 By _____

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9. CLAIMS APPENDIX

1. (Canceled).

2. (Previously Presented) A combustion control apparatus for an internal combustion engine, comprising:

an exhaust purifier in an exhaust passage of the internal combustion engine;

a combustion controlling actuator to cause main combustion, and to cause preliminary combustion prior to the main combustion; and

a controller to control fuel injection to produce the preliminary combustion, and to control fuel injection to start the main combustion after an end of the preliminary combustion;

wherein the combustion controlling actuator includes a fuel injector to inject fuel directly into a combustion chamber of the engine; and the controller is configured to perform a preliminary fuel injection to produce the preliminary combustion at or near top dead center, and to perform a main fuel injection to start the main combustion after the preliminary combustion is finished such that a premixed combustion process is predominant in the main combustion, the preliminary fuel injection being immediately prior to the main fuel injection, and

wherein the controller is configured to perform the preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center.

3. (Original) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to control the combustion controlling actuator in a split combustion mode by controlling the fuel injection to produce the preliminary combustion at or near top dead center, and by controlling the fuel injection to start the main combustion after the end of the preliminary combustion when a split combustion request is produced to bring the exhaust purifier to an operative state.

4. (Original) The combustion control apparatus as claimed in Claim 3, wherein the controller is configured to control the combustion controlling actuator normally in a normal combustion mode, and to change over a combustion control mode from the normal combustion mode to the split combustion mode in response to the split combustion request produced in accordance with a condition of the exhaust purifier.

5. (Original) The combustion control apparatus as claimed in Claim 4, wherein the controller is configured to determine an estimated condition of the exhaust purifier and to produce the split combustion request in accordance with the estimated condition of the exhaust purifier, to request one of an increase in an exhaust gas temperature of the engine and a rich operation of the engine.

6. (Previously Presented) The combustion control apparatus as claimed in Claim 5, wherein the combustion control apparatus further comprises a condition sensor to

collect information needed to determine the estimated condition of the exhaust purifying section.

7. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to delay the start of the main combustion with respect to the end of the preliminary combustion.

8. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to perform the main fuel injection for the main combustion at a timing to start the main combustion after an end of a heat releasing process of the preliminary combustion.

9. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to start the main fuel injection for the main combustion at a timing to inject fuel in a state in which flame subsides in the combustion chamber, to prevent diffusive combustion process in the main combustion.

10. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to control a preliminary fuel injection quantity of the preliminary fuel injection to a smaller quantity required to increase an incylinder temperature in the combustion chamber, and to make a main fuel injection quantity of the main combustion greater than the preliminary fuel injection quantity, to produce engine torque with the main combustion.

11. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to control a preliminary fuel injection quantity for the preliminary fuel injection equal to a fuel quantity required to make an incylinder temperature in the combustion chamber at a fuel injection timing of the main combustion, higher than or equal to an auto ignition temperature enabling spontaneous ignition in the combustion chamber.

12. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein an amount of retard of a combustion start timing of the main combustion with respect to a combustion start timing of the preliminary combustion is equal to or greater than 20° in crank angle.

13. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein an amount of retard of a combustion end timing of the main combustion with respect to compression top dead center is equal to or greater than 50° in crank angle.

14. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to perform the preliminary fuel injection for the preliminary combustion during a compression stroke.

15. (Canceled).

16. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to vary at least one of a fuel injection quantity and a fuel injection timing of the preliminary fuel injection for the preliminary combustion in

accordance with a compression end temperature which is a temperature in the combustion chamber at an end of a compression stroke.

17. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to control an exhaust gas temperature of the engine by varying the fuel injection timing of the main combustion.

18. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to control the main combustion so as to hold torque produced by the engine constant.

19. (Previously Presented) The combustion control apparatus as claimed in Claim 3, wherein the exhaust purifier includes a particulate filter to collect exhaust particulate matter, and the controller is configured to produce the split combustion request in accordance with an estimated particulate matter quantity of the particulate matter accumulated in the particulate filter, to increase an exhaust gas temperature for auto oxidation of the particulate matter in the particulate filter.

20. (Previously Presented) The combustion control apparatus as claimed in Claim 3, wherein the exhaust purifier includes an NOx trap catalyst device to trap NOx in a lean operation of the engine, and the controller (25) is configured to produce the split combustion request at a time to purify the NOx trapped in the NOx trap device.

21. (Original) The combustion control apparatus as claimed in Claim 20, wherein the controller is configured to produce the split combustion request (Fsp) in accordance with an estimated NOx quantity (Qnox) of the NOx trapped in the NOx trap device.

22. (Original) The combustion control apparatus as claimed in Claim 20, wherein the controller is configured to produce the split combustion request in accordance with a distance traveled by a vehicle powered by the internal combustion engine.

23. (Previously Presented) The combustion control apparatus as claimed in Claim 3, wherein the exhaust purifier includes an NOx trap device to trap NOx in a lean operation of the engine, and the controller is configured to produce the split combustion request at a time to purify sulfur content trapped in the NOx trap device.

24. (Original) The combustion control apparatus as claimed in Claim 23, wherein the controller is configured to produce the split combustion request in accordance with an estimated sulfur content quantity of the sulfur content trapped in the NOx trap device.

25. (Original) The combustion control apparatus as claimed in Claim 23, wherein the controller is configured to produce the split combustion request in accordance with a distance traveled by a vehicle powered by the internal combustion engine.

26. (Previously Presented) The combustion control apparatus as claimed in Claim 3, wherein the exhaust purifier includes an NOx trap catalyst device to trap NOx in a lean operation of the engine, and the controller is configured to produce the split combustion request at a time to warm up the NOx trap device.

27. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the controller is configured to perform a plurality of preliminary fuel injections to cause a plurality of heat releasing processes for the preliminary combustion prior to the main combustion so that at least one of the heat releasing processes of the preliminary combustion is produced at or near top dead center.

28. (Original) The combustion control apparatus as claimed in Claim 27, wherein the controller is configured to perform a plurality of preliminary fuel injections to cause a plurality of heat releasing processes for the preliminary combustion in a low engine load region.

29. (Previously Presented) The combustion control apparatus as claimed in Claim 2, wherein the combustion control apparatus further comprises the internal combustion engine which is a diesel engine.

30. (Previously Presented) A combustion control process for an internal combustion engine provided with an exhaust purifier in an exhaust passage of the internal combustion engine, the combustion control process comprising:

controlling fuel injection to produce preliminary combustion in an engine cycle by performing a preliminary fuel injection to produce the preliminary combustion at or near top dead center; and

controlling fuel injection to start main combustion after an end of the preliminary combustion in the engine cycle by performing a main fuel injection such that a

premixed combustion process is predominant in the main combustion, the preliminary fuel injection being immediately prior to the main fuel injection,

the preliminary fuel injection being performed at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center.

31. (Previously Presented) The combustion control process as claimed in Claim 30;

determining an estimated condition of the exhaust purifier;

producing a split combustion request in accordance with the estimated condition of the exhaust purifier;

changeover a combustion control mode from a normal mode to a split combustion mode in response to the split combustion request; and

controlling the fuel injection to produce the preliminary combustion and the fuel injection to start the main combustion after the end of the preliminary combustion in the split combustion mode.

32. (Previously Presented) A combustion control apparatus for an internal combustion engine, comprising:

means for determining an estimated condition of an exhaust purifier in an exhaust passage of the internal combustion engine;

means for producing a split combustion request in accordance with the estimated condition of the exhaust purifier; and

means for controlling fuel injection to the engine in a split combustion mode in response to the split combustion request by controlling fuel injection to perform a preliminary fuel injection to produce preliminary combustion and controlling fuel injection to perform a main fuel injection to start main combustion after an end of the preliminary combustion such that a premixed combustion process is predominant in the main combustion, the preliminary fuel injection being immediately prior to the main fuel injection,

the means for controlling the fuel injection including means for performing the preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center,

the means for controlling the fuel injection including means for performing the preliminary fuel injection at such a timing as to cause a heat releasing process of the preliminary combustion to start before compression top dead center and to end after compression top dead center.

33. (Previously Presented) The combustion control process as claimed in Claim 30, wherein the preliminary fuel injection for the preliminary combustion is performed during a compression stroke.

34. (Previously Presented) The combustion control process as claimed in Claim 30, wherein the preliminary fuel injection is performed at such a timing as to cause a heat releasing process of the preliminary combustion to start before a compression top dead center and to end after the compression top dead center.

35. (Previously Presented) The combustion control process as claimed in Claim 30, wherein the start of the main combustion is delayed with respect to the preliminary combustion.

36. (Previously Presented) The combustion control apparatus as claimed in Claim 32, wherein the means for controlling the fuel injection to the engine in the split combustion mode includes means for decreasing a percentage of diffusive combustion in the main combustion and instead increasing a percentage of premixed combustion in the main combustion by delaying a start of the main combustion after the end of the preliminary combustion.

10. EVIDENCE APPENDIX

None.

11. RELATED PROCEEDINGS APPENDIX

None.